**BAY AREA AIR QUALITY MANAGEMENT DISTRICT**

**939 ELLIS STREET**

**SAN FRANCISCO, CALIFORNIA 94109**

June 16, 1997

# DRAFT
# STAFF REPORT

## Regulation 8, Rule 18
## Equipment Leaks


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## INTRODUCTION

Fugitive emissions are emissions from many scattered sources as compared to emissions from one emission point such as a "smoke stack". Each fugitive source (leaking equipment) contribution is usually very small. However, in the case of valves, connectors, pumps, and compressors, leaks are quite significant. This is primarily due to the large number of these sources. Compared to point sources, these fugitive sources are also usually relatively close to ground level. Thus leaks of toxic compounds from these devices can have a much larger impact than the equivalent emission from an elevated stack source (Reference 1).

Valves and connectors are very common. Every home has many valves and connectors. In general, any industrial facility using or handling liquid or gaseous organic compounds will have a significant number of valves and connectors. Most of the Bay Area Refineries each have at least 20,000 valves that are subject to the current valve and flange rule. The number of connectors is much larger.

Pumps and compressors are also very common. Most homes have refrigerators, clothes and dish washers which contain compressors and pumps. Again, as in the case of valves and connectors, any industrial facility which handles liquid or gaseous organic compounds will have a number of pumps or compressors. Typically the number of pumps is a very small portion of the number of valves. The number of compressors usually is even a smaller portion.

## OVERVIEW

Present technology achieves the current rule requirements with a very labor intensive leak detection and repair program (LDAR). Since the District must achieve additional reductions in hydrocarbon emissions if it is to meet the California Clean Air Act Standards and maintain attainment of Federal Clean Air Act Standards., staff must find additional methods of reducing emissions while reducing the burden on affected industries.

The goals of these proposed rule modifications are:

- To provide a simple set of rules.
  A single rule that is applicable to any leaking component that is clear and easy to understand by the affected facilities and regulators.

- To lower the frequency of leaks.
  To achieve significant emission reductions.

- To encourage the use of upgraded technology.
  To achieve emission reductions in the present and in the future.

- To set standards that do not dictate technology and provide operational flexibility.
  To allow industry to choose the best technology for their particular application.

- To propose a set of rules that are readily enforceable.
  To help the District insure compliance with the regulations.

- To expand the applicability of the rules.
  To obtain additional emission reductions from all leaking equipment.

## PRESENT PROGRAM

The present fugitive emission programs require components be monitored with analyzers to detect leakage as a VOC concentration and repaired if leaking. The rules permit a leaking component which cannot be repaired to be placed on a list to be repaired at the next turnaround (which could be several years).

One serious deficiency with the present Leak Detection and Repair (LDAR) program is that it can allow high mass emissions. A small fraction of the components can leak at unknown (potentially very high) mass rate, until repaired at the next turnaround. When the concentration measurement is converted to a mass emission number, the accuracy of the converted value is questionable.

The following issues have been identified with the present LDAR systems:

- Leak checking is tedious and time consuming, i.e., it is resource intensive.
- To be enforceable, they require an extensive District staff checking for leaks.
- They do not distinguish large from small leaks, i.e. the mass emissions from a 10,000 ppm leak may be small or large.
- They do not quantify mass emissions. Consequently, mass emissions may not be reduced.
- They do not prioritize or provide an incentive to reduce the highest emitting components.

- They prevent innovative leak detecting technology from being developed, i.e. laser imaging, IR. etc. They define what is to be done, how and when.

## AMENDMENT PROPOSAL OVERVIEW

The proposal will incorporate all fugitive emission rules and sources into one rule, Regulation 8, Rule 18: Equipment Leaks. This will result in consistency with state and federal regulations and incorporate sources that currently fall outside of the current fugitive emission rules.

The proposed amendments are intended to provide environmental protection in a common sense and cost effective manner. Amendment goals include eliminating obsolete and unnecessary requirements, providing operational flexibility and providing the flexibility to test alternative strategies to achieve environmental goals. Operational flexibility is intended to allow industry greater freedom in devising methods of ensuring the achievement of environmental goals. The intent is to develop innovative strategies that meet and exceed environmental standards while cutting costs.

The objective of the amendments is to insert compliance options into the present LDAR systems rule that will allow and give incentives to use flexible detection systems and simple mass emission measuring systems for the few components that are found to be leaking. Staff is proposing that more responsibility and accountability be given to the facilities to encourage innovative technologies and techniques to accomplish low leak rates. This is to be accomplished by encouraging the facilities to quantify actual emissions from leaking components and repair the high emitters. They are encouraged to devise and implement their own programs to control leaks. Any facility will be allowed to return to the traditional LDAR program at any time.

This program would have the following advantages:

- It will allow facilities complete flexibility to develop an improved fugitive emission reduction program.
- It will provide verifiable, measurable performance through direct mass measurement.
- It will allow for independent verification of performance.
- It will encourage development of innovative leak detection and repair systems.
- It will encourage facilities to concentrate resources on the highest emitting sources.
- It will provide operational flexibility for facilities.
- It will remove the mandate for facilities to continue the existing

command and control strategy, LDAR program.

- It will focus the efforts of the facilities in the most cost effective manner.
- It will focus the emission reducing efforts on the significant leaking components.

## PROPOSED RULE AMENDMENTS

### Proposal

The following four options will be incorporated into a single fugitive emission rule covering all fugitive emission sources:

**Option 1:** Continue to use the existing LDAR program at the existing trigger levels of 500 ppm for pumps and compressors and 100 ppm for all other equipment.

**Option 2:** Using the above Option 1 concentration standards as trigger levels, any non-repairable component can be measured for mass emissions. If the emission mass is high (greater than 15 lb/day), the component must be repaired, if low (less than 0.1 lb/day) , no further action will be required.

**Option 3:** Using the above Option 1 concentration standards as trigger levels, facilities can increase the interval between inspections for components that do not leak.

**Option 4:** Facilities will be allowed an option to implement their own unique program to reduce emissions from leaks.

### Proposal Discussion

Valves, connections, pumps and compressors will continue to be subject to the existing LDAR program with trigger levels of 500 ppm for pumps and compressors and 100 ppm for all other equipment. Connections will have the option to be included in an annual inspection program. The concentration standard for pressure relief devices will drop from 10,000 ppm to 100 ppm.

All equipment subject to a LDAR program with leaks discovered by the operator must be minimized within 24 hours and repaired within 7 days. All leaks discovered by the APCO must be repaired within 24 hours. All equipment not subject to a LDAR program discovered to be leaking by

the APCO will be immediately in violation of this rule.

An option for facilities to avoid violation and reduce emissions significantly is to use the concentration standards as trigger levels and measure any non-repairable component for mass emissions. If the emission mass is high (greater than 15 lb/day), the component must be repaired, if low (less than 0.2 lb/day for pumps and compressors, 0.1 lb/day for all other equipment) , no further action will be required.

The mass emission maximum allowable value of 15 lb/day is transferred from the current BAAQMD Regulation 8, Rule 2, Section 301. All sources are currently subject to this standard.

The 0.2 lb/day for pumps and compressors and 0.1 lb/day for all other components is derived from the WSPA/API Study correlation equations.

Another option aimed at reducing the cost of the rule is the option to increase the interval between inspections for components that do not leak. The inspection frequency for equipment, except pumps and compressors, may change from quarterly to annually provided the equipment has been operated leak free for five consecutive quarters and records are submitted and approval from the APCO is obtained. If a leak is discovered, the inspection frequency will revert back to quarterly.

The final option will allow facilities to implement their own unique program to reduce emissions from leaks.

The following is a proposed Workplan for this program:

Task 1 - Commitment

Facility management must commit in writing to implement a verifiable emission reduction program. They must get District, EPA and the appropriate State Agency acceptance. EPA has indicated that they will provide a letter to the participating facilities that hold existing LDAR program requirements in abeyance during the volunteer program. The abeyance will not cover pending enforcement actions.

Task 2 - Establish Baseline

Using an independent auditor, measure the fugitive emissions from the participating facility. This will involve identifying the process units to be measured and locating the leaking components using EPA Method 21 traditional LDAR measurement protocol. For leakers that exceed the leak definition, the auditor will measure the mass rate directly by any means acceptable to the District: bagging, high volume measurement, etc. Emissions from the leaking components will then be calculated using both the actual measurements and the API/WSPA correlation factors.

Task 3 - Establish New Mass Emission Targets

The data from Task 2 will be evaluated for acceptance by the District and will be used to establish a new lower mass emission target for the participating facilities. The mass emission target levels will be below those levels found in Task 2 e.g. 80% of Task 2 baseline.

Task 4 - Plan Emission Reduction Programs

The facility must develop a plan to achieve the new mass emission targets. The plan will simply document the steps or process each participating facility will use to achieve the new targets. The plan may include new innovative leak detection techniques, equipment replacement, additional controls, better monitoring, maintenance and timelines.

For greater flexibility the facility would be allowed to identify leaking components by any reasonable means: soap bubbles, VOC screening, audio detection, $S^3$, laser, IR, etc. Once leakers are found the mass rate can be measured by any acceptable means: bagging, high volume measurement, etc.

Task 5 - Program Implementation

In this task the facilities will implement the Emission Reduction Programs from Task 4. The facilities will document their procedures, progress made, the data used to verify that the emission target is being met, and issue periodic reports to the District.

Task 6 - Independent Verification

After the participating facility program has been in place for twelve months the District will verify that the Emission Reduction Program is achieving the emission targets established in Task 3.

Task 7 - Future Participation

The facility may elect to continue with the Emission Reduction Program if they meet mass emission target levels or return to the existing LDAR program. Audit results will be reviewed by the District to determine if they meet expectations. If a facility chooses to continue with the Emission Reduction Program an independent audit will be performed periodically, once a year, to ensure continued compliance.

## FUGITIVE EMISSION DATA

There are many fugitive emission estimating methods that yield a wide range of results (estimates may vary as much as a factor of 100 depending on the method selected). To estimate emissions for this study, US-EPA fugitive emission estimating methods published in the report: 1995 EPA Protocol (Reference 10), and the BAAQMD Rule Effectiveness Study (Reference 9) were used. This EPA report presents a number of methods for estimating refinery emissions and the method selected is the "Leak/No Leak Approach". This method uses the screening data (the hydrocarbon concentration) to calculate the mass emission rates based on the component leak level (above or below 10,000 ppm). These correlations are specific to the type of component and differentiate between valves, connectors, pumps, compressors, open-ended lines and pressure relief valves. The Leak/No-Leak Method was selected because a recent EPA Report comparing estimating methods to mass measurements, by bagging, indicated this method gave the best correlation. These study results are summarized in Table 3-4 of the EPA Report: Evaluation of the High Volume Collection Reference 11). The screening data taken at the interface was used in these calculations since this is what EPA uses and what has been used in deriving the correlations.

To predict emissions, the Rule Effectiveness Study audit data was entered into a spreadsheet program. A "leak" in this report is defined as >100 ppm for valves and connectors, and >500 ppm for pumps and compressors. The component counts are slightly different from those listed in the Leaking Equipment Totals Tables, because of two reasons: 1) tagged (leaking components identified prior to audit) valves and connectors are included and, 2) flanges and open-ended-lines are treated as connectors.

The results of the emission estimate are presented in the table below. Four categories are shown: valves, connectors, pumps and liquid leaks. The District-wide emission estimate is for the five refineries that participated in the recent WSPA/Radian fugitive emission study: Chevron, Exxon, Shell, Tosco and Unocal (now Tosco Rodeo).

| | | Leaks | Audit Group | District-wide |
|---|---|---|---|---|
| **Valves** | Count | 92 | 7,787 | 180,323 |
| | Emission(lb/day) | 81 | 308 | 7,125 |
| **Connectors** | Count | 115 | 21,158 | 901,615 |
| | Emission(lb/day) | 66 | 132 | 5,638 |
| **Pumps** | Count | 5 | 137 | 2,140 |
| | Emission(lb/day) | 3 | 95 | 1,477 |
| **Liquid Leaks** | Count | 5 | 5 | 116 |
| | Emission(lb/day) | 1 | 1 | 23 |
| **Grand Total** | Emission(lb/day) | | | 14,263 |
| | (ton/yr.) | | | 2,600 |

Flanges and Open Ended Lines have not been listed as separate categories and the few that were checked have been placed in the category of connector. Liquid Leaks are those components that were found to be dripping liquid. These were quantified by counting drops per minute and assuming a 1/8 inch droplet size.

The second column in this table is the Audit Group and the projected emissions of the audit group. This was done by using the audit group count size (the number of components checked) and adding in emissions for the checked components that were below the recording limit (100 ppm for valves and connectors and 500 ppm for pumps). The EPA method provides emission estimates for components that measure below the Leak/No-Leak threshold (10,000 ppm).

The third column in the table is a projection to District-wide emissions which is the total estimated fugitive emissions for the components audited projected over the five refineries that participated in the WSPA/Radian Report on Evaluation of the Cost of Compliance (Reference 12). The total valve count of 180,323 and total pump count of 2,140 is taken from the Radian Study. The connector count of 901,615 is derived by assuming there are five connectors for every valve. Observations during the audit indicated connector-to-valve ratios varied from about 3:1 to 15:1. Therefore, 5:1 is considered a reasonable value. It is

assumed the leak data taken in this audit is representative of the district-wide population. Actual emissions may be higher than those estimated because inaccessible components were not checked and they are expected to have higher leak rates than accessible components.

A comparison was made of the frequency of leaks and emission estimates in this audit compared to the WSPA/Radian Study. This study was done for the five major refineries in the Bay Area based on data gathered in Second Quarter 1995. This comparison is presented in the following table.

| | | **Radian Study** (2Q95) | **BAAQMD Audit** (March 97) |
|---|---|---|---|
| **Valves** | >500 ppm | 1.0% | 0.5% |
| | >100 ppm | 2.1% | 1.1% |
| | Emission (lb/day) | 246 | 7125 |
| **Pumps** | >1000 ppm | 3.4% | 0.7% |
| | >500 ppm | 4.9% | 2.9% |
| | Emission (lb/day) | 65 | 1477 |

These figures indicate the percentage of leaks has decreased since 1995, but there is a large difference in the emission estimates due to the use of different estimating techniques. The Radian Study used EPA Correlation Equations while the BAAQMD estimate used the Leak/No- Leak method.

## REFERENCES


1 "National Emission Standards for Hazardous Air Pollutants; Announcement of Negotiated Regulation for Equipment Leaks", Federal Register, Vol 56, No 9315, 40 CRF Ch 1 [FRL-3910-3], March 6, 1991

2 Rule 1173, Fugitive Emissions of Reactive Organic Compounds, South coast Air Quality Management District.

3 "Controlling Petroleum Refinery Fugitive Emissions Via Leak Detection and Repair", B.A. Tichenot, K.C. Hustvedt, and R.C. Weber, EPA-600/9-80-013

4 "Compilation of Air Pollution Emission Factors", EPA publication AP-42, September, 1985

5 "Valve Screening Study at Six San Francisco Bay Area Petroleum Refineries", R.L. Honerkamp, et. al., Radian Report DCN 79-219-370-03, January 24, 1979.

6 "Study of Fugitive Emissions Data from Bay Area Refineries", Western States Petroleum Association report done by Radian DCN: 91-256-168-01, March 6, 1991

7 Staff Report for Rule 1142, Peter Votlucka, J.D. Nadler, Karen Fisher, South Coast Air Quality Management District, May 25, 1991

8 "Protocols for Generating Unit-Specific Emissions Estimates for Equipment Leaks of VOC and VHAP", EPA-450/3-88-010, October 1988

9 "Rule Effectiveness Study: Valves and Connectors, Pumps and Compressors Seals at Refineries, Chemical Plants, Bulk Plants and Bulk Terminals", D. Wocasek and M. Wedl, Bay Area Air Quality Management District, May, 1997

10 “1995 Protocol for Equipment Leak Emission Estimates (EPA-453/R-95-017)”, U. S. EPA, November, 1995

11 "Evaluation of the High Volume Collection System (HVCS) for Quantifying Fugitive Organic Vapor Emissions (EPA-600/R-95-167)", EPA Report, November 1995.

12 "Evaluation of the Cost of Compliance with 1997 Provisions of BAAQMD Regulation 8 Rules 18 and 25", WSPA/Radian Study Report, Radian International, December 20, 1996.

# APPENDIX A: COPY OF PROPOSED RULE MODIFICATIONS

Attached is a copy of the proposed Regulation 8, Organic Compounds, Rule 18: Equipment Leaks. This rule will supersede the previous Regulation 8, Rule 18: Valves and Connectors, Regulation 8, Rule 25: Pumps and Compressors and Regulation 8, Rule 28: Pressure Relief valves.

All unchanged provisions transferred from the current Regulation 8, Rule 18 (Valves and Connectors), Rule 25 (Pumps and Compressors) and Rule 28 (Pressure Relief Valves) are presented as normal text. Proposed changes to the rules are presented as underlined text.